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A summary report is presented of the emission inventory for the San Juan, Puerto Rico Metropolitan Area. The report provides estimates of the present levels of air pollutant emissions and status of their control. The pollutants, which include sulfur oxides, particulates, carbon monoxide, hydrocarbons, and nitrogen oxides, are delineated with respect to source type, season of the year, and geographical distribution within the area. The Study Area is comprised of nine municipalities surrounding San Juan. A grid coordinate system was used to show the geographical distribution of emissions within the municipalities. All sources of emissions were classified into one of five categories: transportation, stationary fuel combustion, solid waste disposal, industrial process losses, and evaporative losses.

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SAN JUAN, PUERTO RICO METROPOLITAN AREA
AIR POLLUTANT EMISSION INVENTORY

Prepared by:

David S. Kircher

Details of illustrations in this document may be better studied on microfiche

ENVIRONMENTAL PROTECTION AGENCY
Air Pollution Control Office
Division of Air Quality and Emission Data
Research Triangle Park, North Carolina
January 1971

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PREFACE

This report, which presents the emission inventory for the Puerto Rico Area, is one in a series of surveys outlining the sources and emissions of air pollutants for major metropolitan areas in the country. These surveys, conducted by the National Inventory of Air Pollutant Emissions and Control Branch of the National Air Pollution Control Administration, provide estimates of the present levels of air pollutant emissions and the status of their control. The pollutants, which include sulfur oxides, particulates, carbon monoxide, hydrocarbons and nitrogen oxides, are delineated with respect to source type, season of the year and geographical distribution within the area. The general procedure for the surveys is based upon the rapid survey technique for estimating air pollutant emissions.[1] These reports are intended to serve as aids in the proposing of boundaries of Air Quality Control Regions, as directed by the Air Quality Act of 1967.

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INTRODUCTION

This report is a summary of the San Juan, Puerto Rico area air pollutant emission inventory conducted in February, 1970. Since all inventories are based upon a calendar year, the data and emission estimates are representative of 1969 and should be indicative of the conditions which existed during that year.[2]

The Study Area is comprised of nine municipalities surrounding San Juan. The total 1969 population was 858,300.

A grid coordinate system was used in the Study Area to show the geographical distribution of emissions within the municipalities. This grid system consisted of 62 square grid zones, ranging from four square kilometers to 16 square kilometers.

All sources of emissions were classified into one of five categories--transportation, stationary fuel combustion, solid waste disposal, industrial process losses, and evaporative losses. Using a criteria of one ton per year minimum of sulfur oxides emissions, approximately 53 large sources were selected and classified as point sources. These sources were located geographically, using a grid reference system. Emissions from the remainder of the sources were distributed to the various grid zones as area sources. These sources included motor vehicle emissions, evaporative losses from filling stations, refuse burning, small commercial and industrial facilities.

As in all emission inventories, the data presented are estimates and should not be interpreted as absolute values. In some cases, the

estimates are partial totals due to the lack of emission factors and production or consumption data. Despite these limitations, the estimates are of sufficient accuracy and validity in defining the extent and distribution of air pollutant emissions within the Study Area.

SUMMARY

The annual emissions as estimated by the San Juan Metropolitan Area Air Pollutant Emission Inventory are:

Sulfur Oxides	89,000
Particulates	7,600
Carbon Monoxide	142,200
Hydrocarbons	25,940
Nitrogen Oxides	32,300

The following is a brief description of the air pollutant emissions as presented in Table 1 and Table 2.

Sulfur Oxides: The largest portion of the sulfur oxides emitted came from the steam-electric plants located in the Study Area. Together these plants accounted for 83 percent of total sulfur oxides. The combustion of fossil fuels by other stationary sources accounted for 14 percent of the sulfur oxides emitted. The remaining 3 percent was distributed under motor vehicles, refuse disposal and small industries.

Particulates: The majority of the particulate emission (74%) came from transportation and stationary fuel combustion sources. Individual sources of particulates from industrial processes accounted for only 5 percent of total particulate emissions. The open burning of solid waste was the only other significant source of particulates, accounting for 21 percent of the total.

Carbon Monoxide: In most metropolitan areas the largest source of carbon monoxide emissions is from automobiles and other motor vehicles. This was also true in Puerto Rico as motor vehicles contributed 59 percent of the carbon monoxide emitted annually. Other transportation sources contributed another 25 percent.

The only other significant source of carbon monoxide was from process sources. This category accounted for about 10 percent of the total emissions.

Hydrocarbons: Exhaust gases from motor vehicles was the primary source of hydrocarbon emissions, accounting for 54 percent of the total. Other smaller evaporative loss sources including gasoline storage and handling, industrial solvent usage, dry cleaning plants, and miscellaneous solvent usage, collectively accounted for 29 percent of total emissions. Other sources included the open burning of solid waste, aircraft operations, and stationary fuel combustion.

Nitrogen Oxides: The largest sources of nitrogen oxides were the steam-electric plants. The combustion of fuel at these plants accounted for 60 percent of total nitrogen oxide emissions. Transportation sources accounted for 28 percent of total emissions.

TABLE 1 SUMMARY OF AIR POLLUTANT EMISSIONS IN STUDY AREA

(Tons/Year, 1969)

Source Category	Sulfur Oxides	Partic-ulates	Carbon Monoxide	Hydro-carbons	Nitrogen Oxides
Transportation					
Road Vehicles	500	900	83,790	7,000	5,730
Other	1,970	2,040	36,280	6,970	3,260
Sub-total	2,470	2,940	120,070	13,970	8,990
Combustion of Fuels in Stationary Sources					
Industry	11,810	720	60	60	2,280
Steam-Electric	73,430	1,880	40	600	19,230
Residential	0	0	0	0	0
Commercial and Institutional	1,000	120	10	10	570
Sub-total	86,240	2,720	110	670	22,080
Refuse Disposal					
Incineration	0	0	0	0	0
Open Burning	100	1,580	8,380	2,960	1,080
Sub-total	100	1,580	8,380	2,960	1,080
Industrial Processes	180	400	13,680	780	120
Evaporative Losses				7,560	
GRAND TOTAL	88,990	7,640	142,240	25,940	32,270

TABLE 2 SUMMARY OF AIR POLLUTANT EMISSIONS IN STUDY AREA, 1969

(10^3 Kg/Year)

Source Category	Sulfur Oxides	Partic-- ulates	Carbon Monoxide	Hydro- carbons	Nitrogen Oxides
Transportation					
Motor Vehicles	450	820	76,010	6,350	5,200
Other	1,790	1,850	32,910	6,320	2,960
Subtotal	2,240	2,670	108,920	12,670	8,160
Stationary Fuel Combustion					
Industry	10,710	650	50	50	2,070
Steam-Electric	66,620	1,710	40	540	17,450
Residential	0	0	0	0	0
Commercial and Institutional	910	110	10	10	520
Subtotal	78,240	2,470	100	600	20,040
Refuse Disposal					
Incineration	0	0	0	0	0
Open Burning	90	1,430	7,600	2,690	980
Subtotal	90	1,430	7,600	2,690	980
Industrial Processes	160	360	12,570	710	110
Evaporative Losses	--	--	--	6,860	--
GRAND TOTAL	80,730	5,930	129,190	23,530	29,290

DESCRIPTION OF STUDY AREA

The San Juan, Puerto Rico Study Area consists of nine municipalities located in the northeast section of the island. These municipalities are Bayamon, Guaynabo, Rio Piedras, Toa Alta, Toa Baja, Catano, San Juan, Carolina and Trujillo Alto.

The population of 858,000 is 32 percent of the total population of Puerto Rico. Figure 1 shows the Study Area in relation to the island of Puerto Rico. Figure 2 is a detailed map of the Study Area, showing the municipality boundaries and the local bodies of water.

The nine municipalities comprising the Study Area are located along the northern coastal plain of Puerto Rico, between the Atlantic Ocean and the central mountain range, which includes 36 percent of the island land area. The land of the coastal plain slopes gradually upward to the central mountain area forming low foot hills to the south of the region.

Temperatures within the Study Area maintain an average of 75° F. in the winter and 80° F. in the summer. The trade winds prevail on the island from the east, northeast, and southeast. These prevailing wind directions in conjunction with the foothills in the southern portion of the region tend to channel pollutants from the Study Area in a westerly direction. Due to the trade winds and the mountains blocking these winds, San Juan averages only five days a year without sunshine.[3]

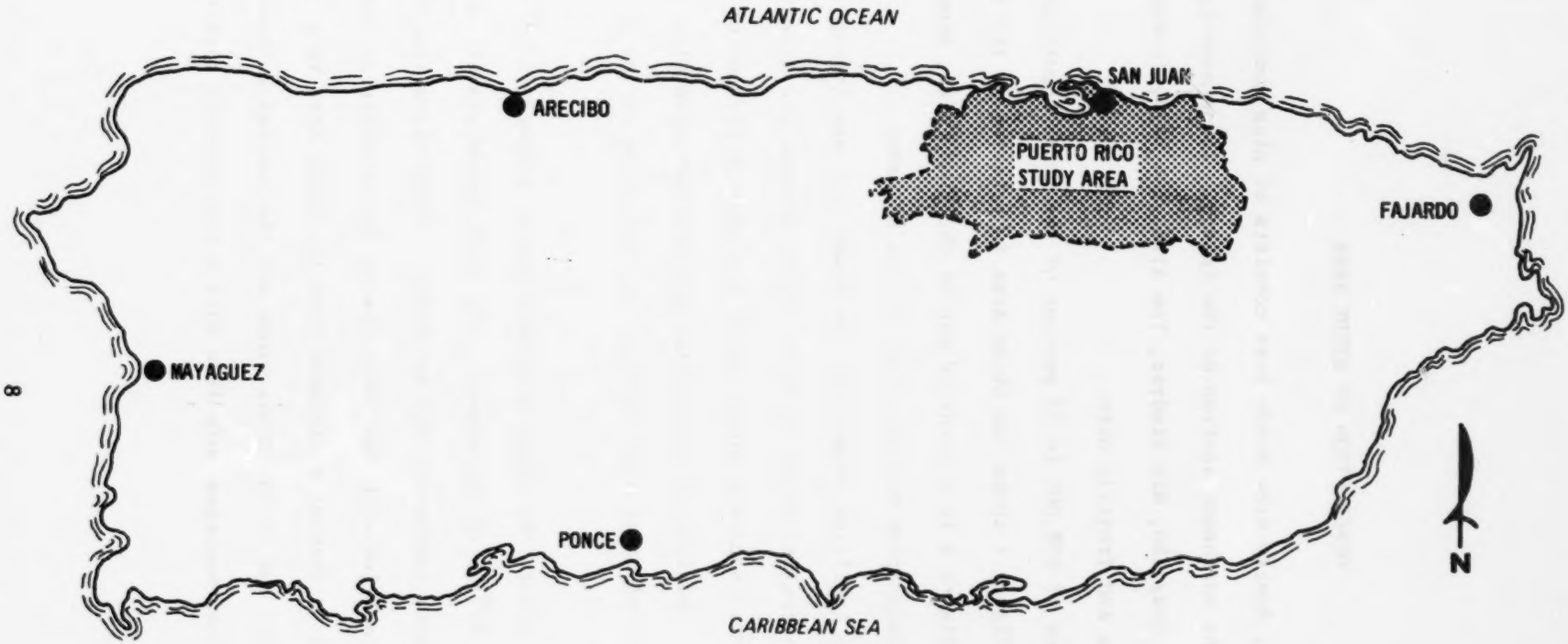

Figure 1. The Isiand of Puerto Rico and the Puerto Rico Study Area.

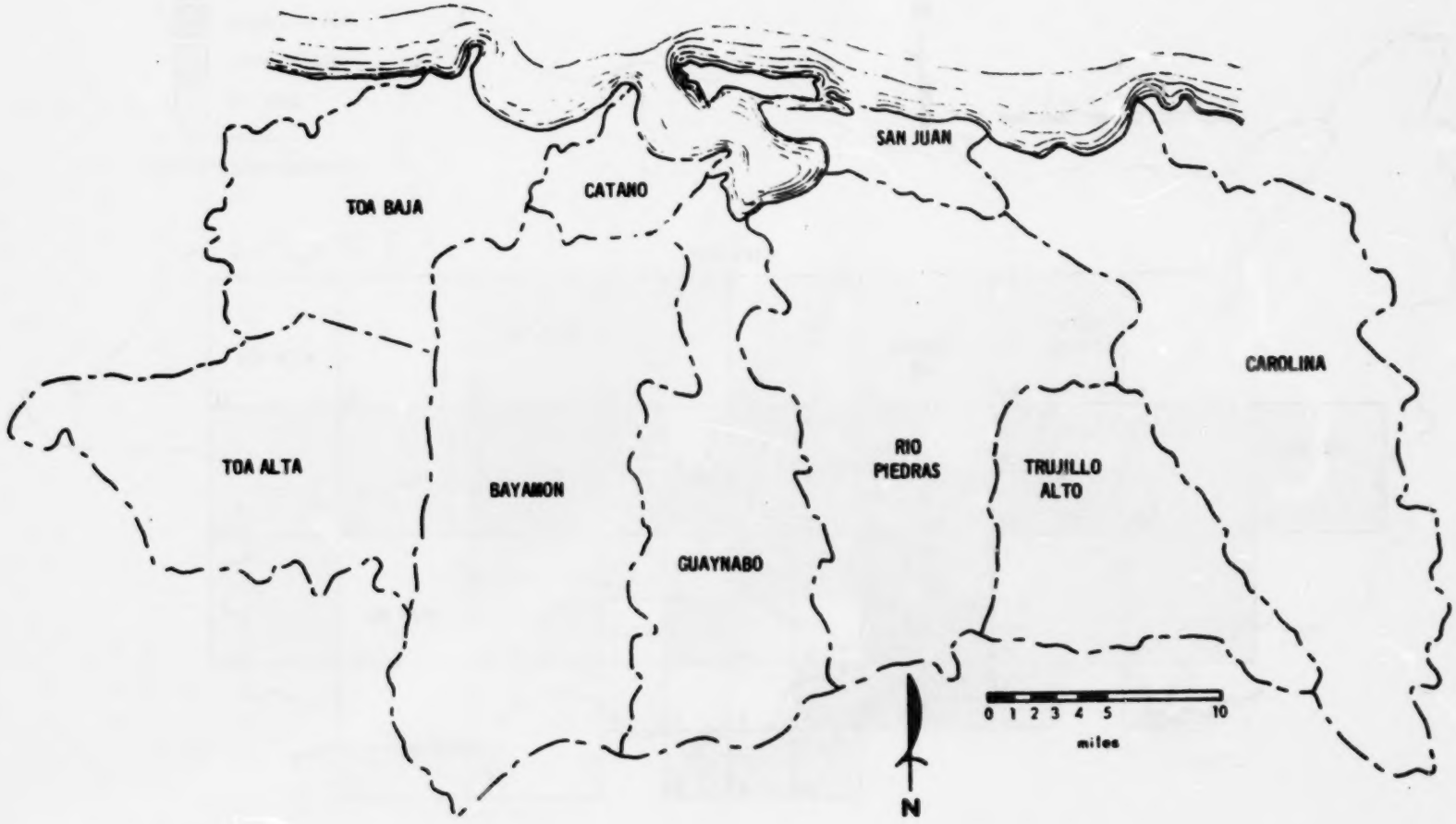

Figure 2. Puerto Rico study area.

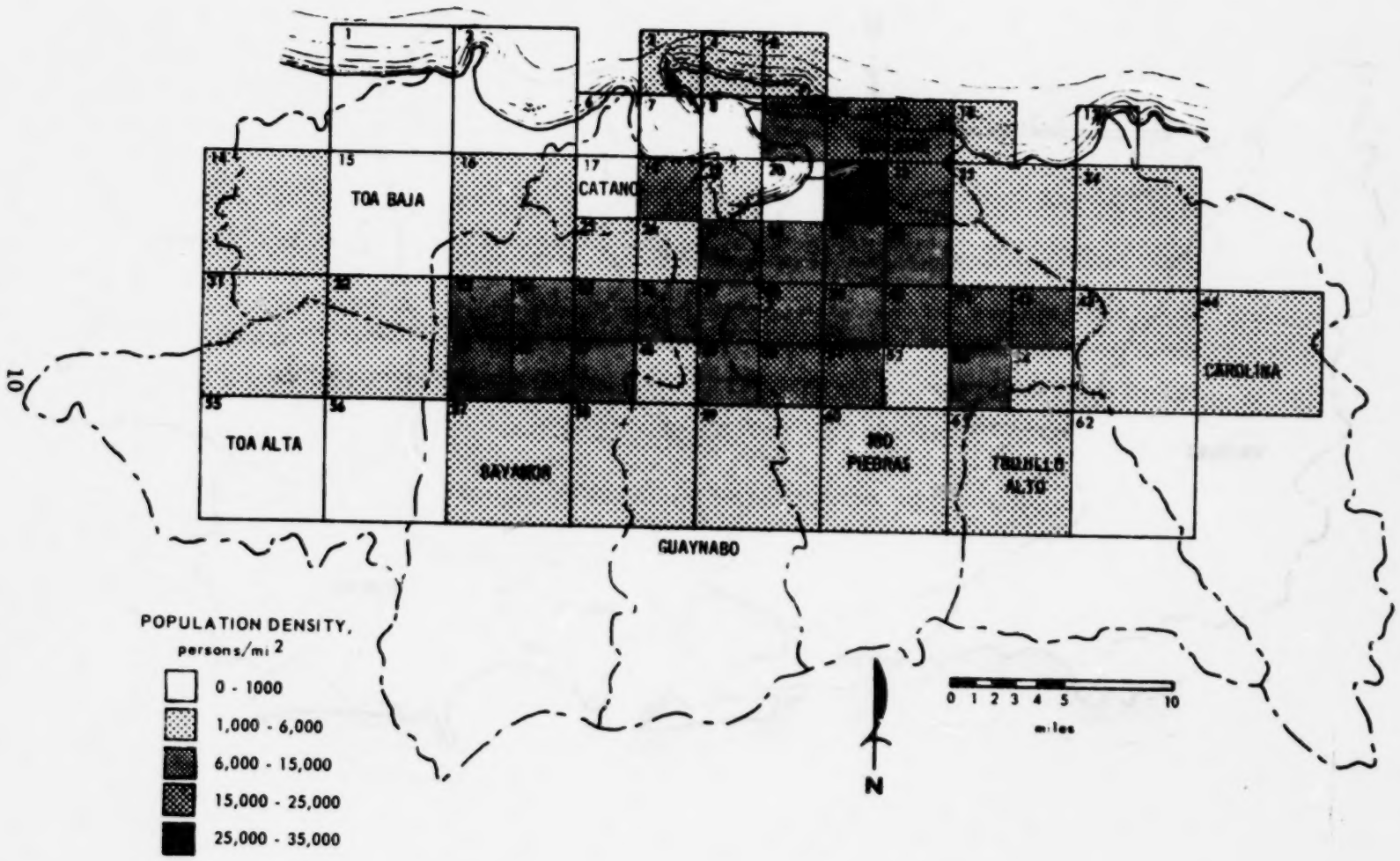

Figure 3. Population density for Puerto Rico study area.

GRID COORDINATE SYSTEM

A grid coordinate system based on the Universal Transverse Mercator Projection (UTM) was used in the San Juan, Puerto Rico Study Area to indicate the geographical distribution of emissions. A map showing the grid coordinate system is presented in Figure 4.

An evaluation of all the available coordinate systems was completed before the UTM system was chosen. The more convenient systems evaluated were the State Plane, the Longitude-Latitude, and the UTM. Although each of the systems had valuable qualities, the UTM coordinate system was thought to be essential to meet the requirements of these emission inventories.

Two primary requisites of the grid coordinate system were used to evaluate each system. The first requirement was the presence of square grid zones, since the data were to be used in meteorological dispersion models. The grid zone projections of the UTM and most of the State Plane systems are always square, but the longitude-latitude system projects grid zones that become skewed as the zones become further from the equator. The second requirement was consistency. Each emission inventory should be conducted on a grid coordinate system which uses the same reference point throughout the Study Area. Since some air pollutant inventories might include areas in two or more states, the State Plane systems could not be used. However, the UTM system, as well as the longitude-latitude system, is not referenced to points in individual states, and thus is not influenced by jurisdictional boundaries. The UTM system was chosen because it was the only prevalent

coordinate system which can project square grid zones over any Study Area using a common reference point.

The Universal Transverse Mercator Projection is based upon the metric system. Each north-south and east-west grid line is identified by a coordinate number expressed in metric, as illustrated in Figure 4. Each point source and grid, using its geographical center, is identified by a horizontal and vertical coordinate to the nearest 100 meters.

Grid zones of different sizes were used in the grid coordinate system to allow a satisfactory definition of the geographical gradation of emissions and to limit the number of grid zones. A basic grid square of two kilometers was used over the more heavily populated areas. Four of these basic squares were combined to form a grid zone of eight kilometers, extending the reference system in the more sparsely populated and industrialized regions. Nineteen 8 kilometer grids and forty-three 4 kilometer grids were used, totaling 62 grid zones.

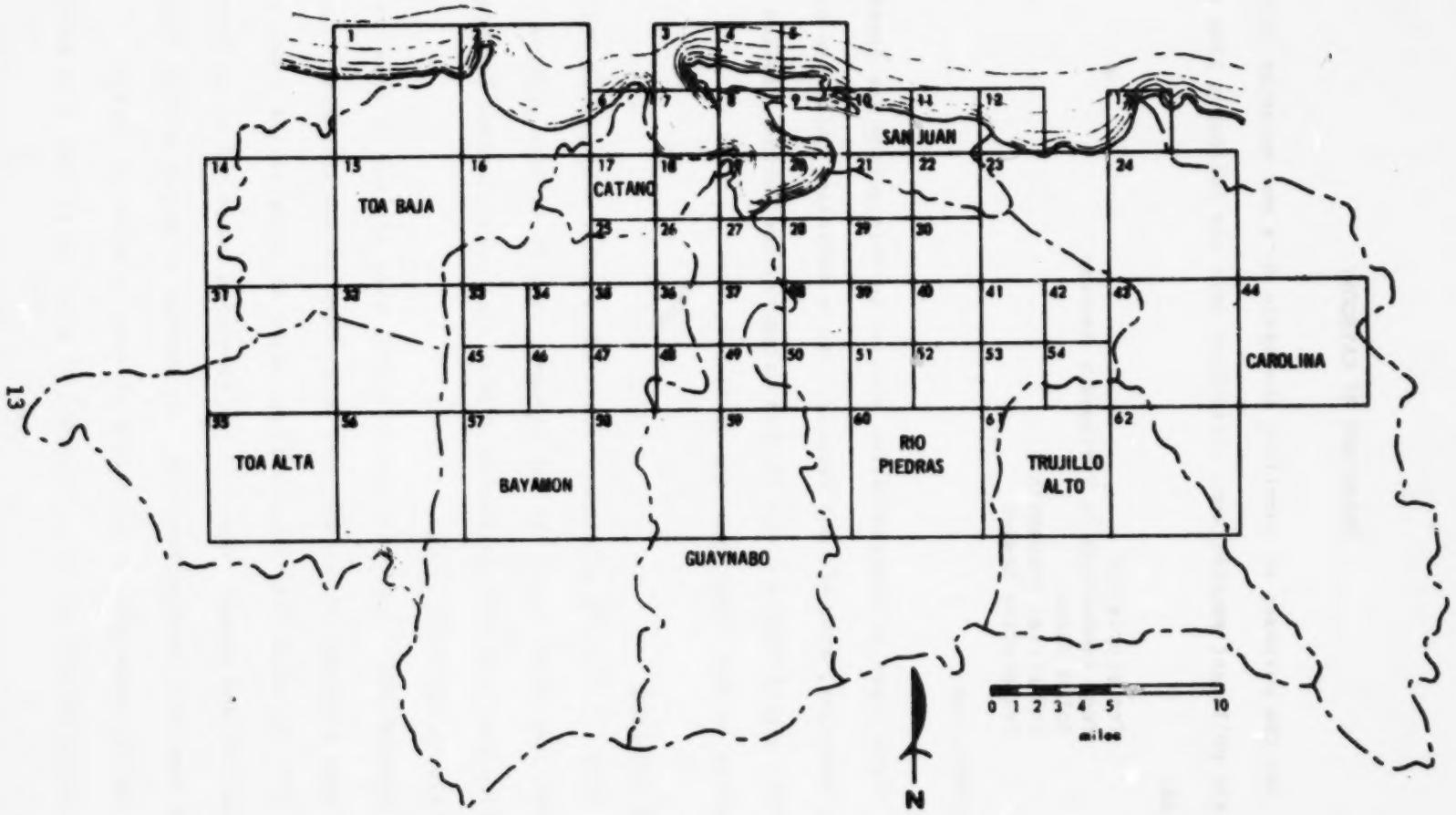

Figure 4. Grid coordinate system for Puerto Rico study area.

EMISSIONS BY CATEGORY

For the purposes of compiling the basic data and emission estimates, the air pollutant sources were classified into the following five categories:

Transportation
Fuel Combustion in Stationary Sources
Solid Waste
Industrial Processes
Evaporative Losses

TRANSPORTATION

Three types of transportation sources in this survey are considered--motor vehicles, aircraft and vessels. Motor vehicles, which are by far the most significant sources in this category, are further divided according to fuel type--gasoline or diesel.

Motor Vehicles

Over 1.1 billion miles were traveled by motor vehicles in 1969 in the San Juan Study Area. In the process, over 86 million gallons of gasoline and 7 million gallons of diesel fuel were consumed for highway purposes in the Study Area.

METHODOLOGY: Vehicle-miles of travel were arrived at from traffic flow maps supplied by the San Juan Department of Public Works. These maps only included flow volumes along major arteries in the Study Area, so gasoline and diesel travel on the remaining roads had to be determined from fuel consumption data. An average miles-per-gallon figure was used in conversion of fuel data to vehicle-miles of travel.

Approximately 1.5 to 2.0 percent of gasoline is lost from gasoline

tank and carburetor losses. (This is exclusive of hydrocarbon exhaust emissions.) It was assumed that no diesel fuel was lost from evaporation. Since 1963 the majority of new automobiles were equipped with positive crankcase ventilation (PCV) valves that reduce hydrocarbon emissions about 90 percent. It was assumed that only 20 percent of the automobiles were not equipped with PCV valves due to lag time in automobile replacement.

RESULTS: Table 3 contains vehicle miles by jurisdiction for the Study Area. Emissions from motor vehicles are included in Table 4.

Aircraft

There are two major airports in the Study Area: Isla Grande and International. Operations were supplied by the local air pollution agency. Table 5 lists aircraft activity in the Study Area. Emissions from aircraft are given in Table 4.

Vessels

Information of the vessel traffic and fuel use in San Juan Harbor was obtained from the local air pollution program personnel. Fuel data for Navy vessels were obtained from the San Juan Naval Station.

Emissions from vessels are included in Table 4.

FUEL COMBUSTION IN STATIONARY SOURCES

The stationary fuel combustion category is concerned with any fixed source which burns fuels for either space heating or process heating. The four primary sources in this category are industrial facilities, steam-electric plants, residential housing, and commercial and institutional establishments. In the San Juan area, natural gas, distillate

TABLE 3 VEHICLE-MILES PER DAY IN THE STUDY AREA, 1969

County	Gasoline Vehicle-Miles	Diesel Vehicle-Miles	Total
Bayamon	407,200	14,800	422,000
Carolina	379,200	13,800	393,000
Catano	80,100	2,900	83,000
Guaynabo	284,700	10,300	295,000
Rio Piedras	970,800	35,200	1,006,000
San Juan	590,600	21,400	612,000
Toa Alta	22,200	800	23,000
Toa Baja	165,000	6,000	171,000
Trujillo Alto	63,700	2,300	66,000
TOTAL	2,963,500	107,500	3,071,000

TABLE 4 SUMMARY OF AIR POLLUTANT EMISSIONS FROM TRANSPORTATION SOURCES, 1969

(Ton/Year)

Source Category	Sulfur Oxides	Partic-ulates	Carbon Monoxide	Hydro-carbons	Nitrogen Oxides
Road Vehicles					
Gasoline	340	460	83,550	6,460	4,840
Diesel	160	440	240	550	890
Sub-total	500	900	83,790	7,010	5,730
Aircraft					
Jet	n	1,710	1,180	340	1,030
Piston	n	160	35,060	6,570	1,650
Turboprop	0	0	0	0	0
Sub-total	n	1,870	36,240	6,910	2,680
Railroads	0	0	0	0	0
Vessels	1,970	180	30	50	580
GRAND TOTAL	2,470	2,950	120,060	13,970	8,990

n = negligible

TABLE 5 AIRCRAFT ACTIVITY IN THE STUDY AREA, 1969

(Flights/Year)

Type Engine	Number of Engines 1	2	3	4
International Airport				
Jet Conventional	0	0	0	1,004
Piston	34,200	67,700	0	9,000
Isla Grande Airport				
Piston	93,500	93,500	0	17,400

oil and residual oil were all in widespread use. Table 6 through Table 8 present a summary of the fuels consumed in the Study Area.

Steam-Electric Utility

METHODOLOGY: Data on the power plants in the area were acquired from questionnaires supplied by the local air pollution control agency. The data included the annual fuel consumption for 1969, type and efficiency of control equipment, sulfur and ash content of the fuel and the type of furnace.

RESULTS: All of the power plants in the area use residual oil-fired boilers with the exception of auxilary gas turbines. Approximately 370 million gallons of oil were consumed in these boilers in 1969.

Air pollutant emissions from fuel combustion at these plants as well as from all other fuel combustion sources are summarized in Table 9. The steam-electric plants were the largest sources of sulfur oxides and nitrogen oxides in the Study Area. Over 82 percent of the total sulfur oxides from stationary fuel combustion and 59 percent of the nitrogen oxides were attributed to power plants.

Industrial

METHODOLOGY: Fuel consumption for a large number of industrial sources was available on an individual basis. Since this is a rapid survey only the 37 largest sources were selected as point sources. The remaining sources were considered collectively as area sources and their fuel use was based on the difference between the total and the amount consumed by the largest sources.

The total quantities of residual and distillate fuel oil consumed by industries were obtained from local air pollution personnel. No space heating is necessary at industrial plants.

RESULTS: Distillate oil and residual oil were used by industrial sources in the Study Area. The consumption of these fuels is summarized in Tables 7 and 8.

Table 9 shows the relative contribution of each fuel to the total emissions from stationary fuel combustion. Industrial sources account for 14 percent of total sulfur oxide emissions, 27 percent of particulates, 75 percent of carbon monoxide, 9 percent of hydrocarbons, and 10 percent of nitrogen oxides from stationary fuel combustion.

Residential

Since use of fuel for space heating is virtually nonexistent in the Study Area, emissions from fuel combustion (cooking and water heating) are considered negligible.

Commercial-Institutional

METHODOLOGY: Commercial and institutional establishments in the Study Area used three types of fuel--distillate and residual oil and natural gas. Data on the total amounts of these fuels used in the area as well as the consumption at individual establishments were supplied by questionnaires on individual sources supplied by the local agency.

RESULTS: The use of fuel oil at commercial and institutional establishments was by far the most significant source of emissions from this category. The contribution to total stationary fuel combustion

TABLE 6 NATURAL GAS CONSUMPTION BY USER CATEGORY, 1969

(millions of cubic feet)

Jurisdiction	Steam-Electric	Industrial	Commercial	Residential
Bayamon	--	--	359	--
Carolina	--	--	217	--
Catano	--	--	73	--
Guaynabo	--	--	182	--
Rio Piedras	--	--	987	--
San Juan	--	--	548	--
Toa Alta	--	--	58	--
Toa Baja	--	--	94	--
Trujillo Alto	--	--	84	--
TOTAL	--	--	2602	--

TABLE 7 DISTILLATE OIL CONSUMPTION BY CONSUMER CATEGORY, 1969

(10^3 Gallons)

Jurisdiction	Steam-Electric	Industry	Commercial Institutional	Residential
Bayamon	--	278	1,074	--
Carolina	--	90	687	--
Catano	--	0	236	--
Guaynabo	--	740	545	--
Rio Piedras	--	269	3,394	--
San Juan	--	310	1,831	--
Toa Alta	--	0	175	--
Toa Baja	--	0	280	--
Trujillo Alto	--	14	252	--
TOTAL	--	1,702	8,474	--

TABLE 8 RESIDUAL OIL CONSUMPTION BY CONSUMER CATEGORY, 1969

(10^3 Gallons)

Jurisdiction	Steam-Electric	Industrial	Commercial-Institutional
Bayamon	--	14,196	--
Carolina	--	653	768
Catano	240,681	2,632	18
Guaynabo	--	37,907	62
Rio Piedras	128,772	2,680	1,091
San Juan	--	984	1,150
Toa Alta	--	--	--
Toa Baja	--	722	--
Trujillo Alto	--	1,915	52
TOTAL	369,453	61,689	3,142

TABLE 9 AIR POLLUTANT EMISSIONS FROM STATIONARY FUEL COMBUSTION, 1969

(Tons/Year)

Fuel	User Category	Sulfur Oxides	Particulates	Carbon Monoxide	Hydrocarbons	Nitrogen Oxides
Fuel Oil						
	Industrial	11,810	720	60	60	2,280
	Steam-Electric	73,430	1,850	10	590	19,210
	Residential	0	0	0	0	0
	Commercial and Institutional	1,000	100	10	10	420
Gas						
	Industrial	0	0	0	0	0
	Steam-Electric	0	0	0	0	0
	Residential	0	0	0	0	0
	Commercial and Institutional	N	20	N	N	150
GRAND TOTAL		86,240	2,690	80	660	22,060

emissions from these establishments was relatively minor.

SOLID WASTE DISPOSAL

Total solid waste generated in the Study Area was arrived at by applying a per capita generation rate of 3.5 pounds/day. Information on the methods of disposal was obtained from the Environmental Health Program, Department of Health in San Juan.

Incineration

There were no large commercial or municipal incineration in use in the area. Information on industrial waste was not available.

Open Burning

Of the four large dumps in the Study Area only one is a sanitary landfill. The remaining three are the open burning type. Daily tonnages were available from the Environmental Health Program for these dumps. Solid waste not disposed of in one of the four dumps was assumed to be disposed of by on-site open burning. Emissions were apportioned to the grids by population.

INDUSTRIAL PROCESSES

Industrial processes are a very minor source of pollutants in this area. Within this category the major sources are: concrete batching, asphalt batching, a fertilizer plant and a petroleum refinery.

EVAPORATIVE LOSSES

The only significant source of hydrocarbons due to evaporative losses is gasoline storage and handling. Emissions were calculated

based on consumption data and were distributed by grid the same as vehicle emissions.

TABLE 10 AIR POLLUTANT EMISSIONS FROM SOLID-WASTE DISPOSAL, 1969

(Tons/Year)

Category	Sulfur Oxides	Partic-ulates	Carbon Monoxide	Hydro-carbons	Nitrogen Oxides
Open Burning					
On-site	60	970	5,170	1,820	670
Dump	40	600	3,210	1,130	420
Sub-total	100	1,570	8,380	2,950	1,090
GRAND TOTAL	100	1,570	8,380	2,950	1,990

EMISSIONS BY JURISDICTION

The previous section presented the air pollutant emissions by source category. Tables 11 through 19 present the emissions by jurisdiction to show the contribution of each municipality to the pollution in the entire Study Area.

TABLE 11 SUMMARY OF AIR POLLUTANT EMISSIONS IN BAYA MON COUNTY TONS/YEAR

SOURCE CATEGORY	SOX	PART	CO	HC	NOX
TRANSPORTATION					
ROAD VEHICLES	68.	122.	13053.	1055.	785.
OTHER	0.	0.	0.	0.	0.
SUB-TOTAL	68.	122.	13053.	1055.	785.
COMBUSTION OF FUELS					
INDUSTRY	2500.	165.	14.	14.	520.
STEAM-ELEC	0.	0.	0.	0.	0.
RESIDENTIAL	0.	0.	0.	0.	0.
COMM AND INST.	54.	11.	1.	1.	59.
SUB-TOTAL	2554.	176.	15.	15.	580.
REFUSE DISPOSAL					
INCINERATION	0.	0.	0.	0.	0.
OPEN BURNING	8.	134.	714.	251.	92.
SUB-TOTAL	8.	134.	714.	251.	92.
PROCESS	183.	3.	13650.	766.	95.
EVAP LOSSES				1042.	

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TABLE 12 SUMMARY OF AIR POLLUTANT EMISSIONS IN CAROLINA COUNTY
TONS/YEAR

SOURCE CATEGORY	SOX	PART	CO	HC	NOX
TRANSPORTATION					
ROAD VEHICLES	64.	115.	10941.	910.	734.
OTHER	0.	99.	21754.	4082.	1020.
SUB-TOTAL	64.	214.	32695.	4993.	1755.
COMBUSTION OF FUELS					
INDUSTRY	102.	7.	0.	0.	26.
STEAM-ELEC	0.	0.	0.	0.	0.
RESIDENTIAL	0.	0.	0.	0.	0.
COMM AND INST.	180.	16.	1.	1.	65.
SUB-TOTAL	282.	24.	2.	2.	91.
REFUSE DISPOSAL					
INCINERATION	0.	0.	0.	0.	0.
OPEN BURNING	29.	464.	2467.	870.	319.
SUB-TOTAL	29.	464.	2467.	870.	319.
PROCESS	0.	335.	0.	0.	0.
EVAP LOSSES				902.	

TABLE 13 SUMMARY OF AIR POLLUTANT EMISSIONS IN CATANO COUNTY TONS/YEAR

SOURCE CATEGORY	SOX	PART	CO	HC	NOX
TRANSPORTATION					
ROAD VEHICLES	13.	24.	1958.	170.	154.
OTHER	0.	0.	0.	0.	0.
SUB-TOTAL	13.	24.	1958.	170.	154.
COMBUSTION OF FUELS					
INDUSTRY	497.	30.	2.	2.	95.
STEAM-ELEC	47835.	1224.	25.	391.	12529.
RESIDENTIAL	0.	0.	0.	0.	0.
COMM AND INST.	15.	2.	0.	0.	13.
SUB-TOTAL	48348.	1257.	28.	394.	12638.
REFUSE DISPOSAL					
INCINERATION	0.	0.	0.	0.	0.
OPEN BURNING	7.	117.	622.	219.	80.
SUB-TOTAL	7.	117.	622.	219.	80.
PROCESS					
EVAP LOSSES	0.	22.	21.	6.	13.
				207.	

TABLE 14 SUMMARY OF AIR POLLUTANT EMISSIONS IN GUAYNABO COUNTY TONS/YEAR

SOURCE CATEGORY	SOX	PART	CO	HC	NOX
TRANSPORTATION					
ROAD VEHICLES	48.	86.	5867.	536.	550.
OTHER	982.	49.	4.	4.	177.
SUB-TOTAL	1030.	135.	5872.	541.	728.
COMBUSTION OF FUELS					
INDUSTRY	7494.	441.	38.	38.	1393.
STEAM-ELEC	0.	0.	0.	0.	0.
RESIDENTIAL	0.	0.	0.	0.	0.
COMM AND INST.	37.	6.	0.	0.	32.
SUB-TOTAL	7532.	448.	39.	39.	1425.
REFUSE DISPOSAL					
INCINERATION	0.	0.	0.	0.	0.
OPEN BURNING	4.	68.	361.	127.	46.
SUB-TOTAL	4.	68.	361.	127.	46.
PROCESS	0.	0.	0.	0.	0.
EVAP LOSSES				689.	

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TABLE 15 SUMMARY OF AIR POLLUTANT EMISSIONS IN RIO PIEDRAS COUNTY TONS/YEAR

SOURCE CATEGORY	SOX	PART	CO	HC	NOX
TRANSPORTATION					
ROAD VEHICLES	164.	295.	27326.	2288.	1880.
OTHER	972.	48.	4.	4.	176.
SUB-TOTAL	1137.	344.	27331.	2293.	2056.
COMBUSTION OF FUELS					
INDUSTRY	491.	32.	2.	2.	105.
STEAM-ELEC	25593.	652.	11.	208.	6702.
RESIDENTIAL	0.	0.	0.	0.	0.
COMM AND INST.	379.	47.	4.	4.	218.
SUB-TOTAL	26464.	732.	19.	215.	7026.
REFUSE DISPOSAL					
INCINERATION	0.	0.	0.	0.	0.
OPEN BURNING	23.	369.	1963.	692.	254.
SUB-TOTAL	23.	369.	1963.	692.	254.
PROCESS	0.	23.	9.	2.	6.
EVAP LOSSES				2532.	

TABLE 16 SUMMARY OF AIR POLLUTANT EMISSIONS IN SAN JUAN COUNTY
TONS/YEAR

SOURCE CATEGORY	SOX	PART	CO	HC	NOX
TRANSPORTATION					
ROAD VEHICLES	100.	179.	19004.	1538.	1143.
OTHER	11.	1844.	14512.	2874.	1887.
SUB-TOTAL	111.	2023.	33516.	4412.	3030.
COMBUSTION OF FUELS					
INDUSTRY					
STEAM-ELEC	212.	14.	1.	1.	48.
RESIDENTIAL	0.	0.	0.	0.	0.
COMM AND INST.	0.	0.	0.	0.	0.
SUB-TOTAL	289.	32.	3.	3.	140.
	502.	46.	4.	4.	188.
REFUSE DISPOSAL					
INCINERATION	0.	0.	0.	0.	0.
OPEN BURNING	12.	204.	1088.	384.	140.
SUB-TOTAL	12.	204.	1088.	384.	140.
PROCESS					
EVAP LOSSES	0.	4.	0.	0.	0.
				1530.	

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TABLE 17 SUMMARY OF AIR POLLUTANT EMISSIONS IN TOA ALTA COUNTY
TONS/YEAR

SOURCE CATEGORY	SOX	PART	CO	HC	NOX
TRANSPORTATION.					
ROAD VEHICLES	3.	6.	482.	43.	42.
OTHER	0.	0.	0.	0.	0.
SUB-TOTAL	3.	6.	482.	43.	42.
COMBUSTION OF FUELS					
INDUSTRY	0.	0.	0.	0.	0.
STEAM-ELEC	0.	0.	0.	0.	0.
RESIDENTIAL	0.	0.	0.	0.	0.
COMM AND INST.	8.	1.	0.	0.	9.
SUB-TOTAL	8.	1.	0.	0.	9.
REFUSE DISPOSAL					
INCINERATION	0.	0.	0.	0.	0.
OPEN BURNING	3.	51.	271.	95.	35.
SUB-TOTAL	3.	51.	271.	95.	35.
PROCESS					
EVAP LOSSES	0.	0.	0.	0.	0.
				79.	

TABLE 18 SUMMARY OF AIR POLLUTANT EMISSIONS IN TOA BAJA COUNTY
TONS/YEAR

SOURCE CATEGORY	SOX	PART	CO	HC	NOX
TRANSPORTATION					
ROAD VEHICLES	28.	50.	3765.	335.	319.
OTHER	0.	0.	0.	0.	0.
SUB-TOTAL	28.	50.	3765.	335.	319.
COMBUSTION OF FUELS					
INDUSTRY	135.	8.	0.	0.	25.
STEAM-ELEC	0.	0.	0.	0.	0.
RESIDENTIAL	0.	0.	0.	0.	0.
COMM AND INST.	14.	2.	0.	0.	15.
SUB-TOTAL	149.	11.	1.	1.	41.
REFUSE DISPOSAL					
INCINERATION	0.	0.	0.	0.	0.
OPEN BURNING	8.	136.	727.	256.	94.
SUB-TOTAL	8.	136.	727.	256.	94.
PROCESS	0.	6.	0.	0.	0.
EVAP LOSSES				393.	

TABLE 19 SUMMARY OF AIR POLLUTANT EMISSIONS IN TRUJ ALTO COUNTY
TONS/YEAR

SOURCE CATEGORY	SOX	PART	CO	HC	NOX
TRANSPORTATION					
ROAD VEHICLES	10.	19.	1392.	125.	122.
OTHER	0.	0.	0.	0.	0.
SUB-TOTAL	10.	19.	1392.	125.	122.
COMBUSTION OF FUELS					
INDUSTRY	378.	22.	1.	1.	69.
STEAM-ELEC	0.	0.	0.	0.	0.
RESIDENTIAL	0.	0.	0.	0.	0.
COMM AND INST.	20.	3.	0.	0.	15.
SUB-TOTAL	399.	25.	2.	2.	85.
REFUSE DISPOSAL					
INCINERATION	0.	0.	0.	0.	0.
OPEN BURNING	1.	31.	165.	58.	21.
SUB-TOTAL	1.	31.	165.	58.	21.
PROCESS	0.	0.	0.	0.	0.
EVAP LOSSES				182.	

EMISSIONS BY GRID

To define the geographical variation of air pollutant emissions in the Study Area, the resulting emissions were apportioned on the grid coordinate system. The emissions were divided into two source groups--point sources and area sources. The 53 point sources are identified individually with respect to location and emissions. Each of these point sources emit more than 1.0 ton per year of Sulfur Oxides.

Figure 5 shows the location of most of the point sources in the area. Collectively, the 53 point sources account for 96 percent of the sulfur oxides, 71 percent of particulates, 37 percent of carbon monoxide, 44 percent of hydrocarbons and 76 percent of nitrogen oxides. The percent contribution to carbon monoxide emissions is low because motor vehicles, which are area sources account for 59 percent of the total carbon monoxide emissions. Table 20 presents the emissions of point sources.

Area sources are sources of emissions that are insignificant by themselves, but as a group emit a significant amount. Examples are motor vehicles, light commercial and industrial establishments and backyard burning. The emissions from area sources have been added to that for point sources to obtain total emissions by grid as given in Table 21.

The emissions are presented for an average annual day, and average winter day (December, January, February) and an average summer day (June, July, August). The annual average daily emission rates were obtained by dividing yearly totals by 365. Seasonal averages were

calculated by the use of space heating variations in fuel consumption.

TABLE 20 SUMMARY OF AIR POLLUTANT EMISSIONS FROM POINT SOURCES
TONS/YEAR

ID	GR	HC	VC	SOX			PART			CO			HC			NOX		
				S	W	A	S	W	A	S	W	A	S	W	A	S	W	A
2	2	17950068300		0.3	0.3	0.3	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.05	0.05
2	2	17950068300		0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	6	18322069440		1.6	1.6	1.6	0.09	0.09	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.30	0.30
2	6	18278069470		0.2	0.2	0.2	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.04	0.04
4	6	18245069150		71.0	71.0	70.1	1.78	1.78	1.76	0.00	0.00	0.00	0.57	0.57	0.56	18.60	18.60	18.34
4	28	18702065870		132.8	132.8	131.0	3.34	3.34	3.29	0.01	0.01	0.01	1.06	1.06	1.05	34.76	34.76	34.28
4	6	18245069150		0.0	0.0	0.0	0.02	0.02	0.02	0.02	0.02	0.02	0.00	0.00	0.00	0.01	0.01	0.01
5	6	18260068750		0.0	0.0	0.0	0.24	0.24	0.24	1.30	1.30	1.30	0.46	0.46	0.46	0.16	0.16	0.16
7	8	18780069330		0.0	0.0	0.0	4.84	4.84	4.84	39.69	39.69	39.69	7.75	7.75	7.75	4.54	4.54	4.54
1	9	18960069710		0.1	0.1	0.1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02	0.02
1	9	18912069990		0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01
2	9	18906068450		0.0	0.0	0.0	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	10	19017068120		0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01
1	10	19031069320		0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01
1	10	19070069250		0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01
1	10	19019069450		0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01
3	10	19125069150		0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01
2	15	17698064270		0.0	0.0	0.0	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	15	17599064930		0.0	0.0	0.0	0.27	0.27	0.27	1.48	1.48	1.48	0.52	0.52	0.52	0.19	0.19	0.19
2	17	18210066300		0.3	0.3	0.3	0.02	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.07	0.07
2	19	18644066190		0.1	0.1	0.1	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03	0.03
2	19	18644066870		0.2	0.2	0.2	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.05	0.05
2	21	19029067900		0.7	0.7	0.7	0.04	0.04	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.13	0.13
1	23	19605067740		0.1	0.1	0.1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02	0.02
1	23	19624067830		0.1	0.1	0.1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02	0.02

TABLE 20 (continued)

7	23	19746067640	0.0	0.0	0.0	0.27	0.27	0.27	59.60	59.60	59.60	11.18	11.18	11.18	2.79	2.79	2.79
2	25	18390064660	6.9	6.9	6.9	0.43	0.43	0.43	37.43	37.43	37.43	2.13	2.13	2.13	1.59	1.59	1.59
2	25	18298065360	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	26	18578065020	15.8	15.8	15.8	0.92	0.92	0.92	0.07	0.07	0.07	0.07	0.07	0.07	2.88	2.88	2.88
2	27	18654065150	0.3	0.3	0.3	0.02	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.07	0.07
2	27	18636065230	0.1	0.1	0.1	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.04	0.04
2	27	18620065320	3.8	3.8	3.8	0.22	0.22	0.22	0.01	0.01	0.01	0.01	0.01	0.01	0.68	0.68	0.68
4	27	18702065870	0.0	0.0	0.0	0.05	0.05	0.05	0.05	0.05	0.05	0.01	0.01	0.01	0.03	0.03	0.03
2	28	18837065585	0.2	0.2	0.2	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.04	0.04
2	28	18817065710	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01
2	29	19143065790	0.1	0.1	0.1	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.04	0.04
2	30	19320065750	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01
5	31	17239060920	0.0	0.0	0.0	0.08	0.08	0.08	0.42	0.42	0.42	0.15	0.15	0.15	0.05	0.05	0.05
2	32	17697063960	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01
2	37	18728062280	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01
2	39	19015062500	0.7	0.7	0.7	0.04	0.04	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.14	0.14
2	39	19185062730	0.0	0.0	0.0	0.02	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	39	19155062730	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	39	19155062730	0.0	0.0	0.0	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	39	19017062740	0.4	0.4	0.4	0.02	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.08	0.08
1	40	19219062910	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03	0.03
2	43	19227062940	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01
2	44	20205060750	0.1	0.1	0.1	0.93	0.93	0.93	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03	0.03
2	44	20440060270	0.1	0.1	0.1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02	0.02
5	44	20439063950	0.0	0.0	0.0	1.04	1.04	1.04	5.57	5.57	5.57	1.96	1.96	1.96	0.72	0.72	0.72
2	47	18325061050	0.2	0.2	0.2	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.04	0.04
2	49	18700061700	0.0	0.0	0.0	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.05	0.05
2	62	19806058720	1.2	1.2	1.2	0.07	0.07	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.21	0.21

TABLE 21 SUMMARY OF AIR POLLUTANT EMISSIONS FROM ALL SOURCES, 1969
TONS/YEAR

GRID	AREA	SOX			PART			CO			HC			NOX		
		S	W	A	S	W	A	S	W	A	S	W	A	S	W	A
1	6.1	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	0.2	0.2	0.2	0.1	0.1	0.1
2	6.1	0.4	0.4	0.4	0.1	0.1	0.1	2.4	2.4	2.4	0.4	0.4	0.4	0.3	0.3	0.3
3	1.5	0.0	0.0	0.0	0.1	0.1	0.1	0.4	0.4	0.4	0.3	0.3	0.3	0.1	0.1	0.1
4	1.5	0.1	0.1	0.1	0.2	0.2	0.2	4.6	4.6	4.6	0.9	0.9	0.9	0.5	0.5	0.5
5	1.5	0.0	0.0	0.0	0.1	0.1	0.1	1.2	1.2	1.2	0.4	0.4	0.4	0.2	0.2	0.2
6	1.5	73.1	73.1	72.1	2.3	2.3	2.2	3.3	3.3	3.3	1.4	1.4	1.4	19.3	19.3	19.0
7	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	1.5	0.0	0.0	0.0	4.8	4.8	4.8	39.7	39.7	39.7	7.8	7.8	7.8	4.5	4.5	4.5
9	1.5	0.5	0.5	0.5	0.3	0.3	0.3	15.9	15.9	15.9	2.4	2.4	2.4	1.3	1.3	1.4
10	1.5	0.4	0.4	0.5	0.2	0.2	0.2	11.8	11.8	11.8	1.9	1.9	1.9	0.9	0.9	1.0
11	1.5	0.1	0.1	0.2	0.1	0.1	0.2	7.5	7.5	7.5	1.3	1.3	1.3	0.5	0.5	0.5
12	1.5	0.0	0.0	0.0	0.0	0.0	0.0	1.9	1.9	1.9	0.3	0.3	0.3	0.1	0.1	0.1
13	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	6.1	0.0	0.0	0.1	0.1	0.1	0.1	2.7	2.7	2.7	0.7	0.7	0.7	0.2	0.2	0.3
15	6.1	0.2	0.2	0.2	0.3	0.3	0.3	1.9	1.9	1.9	0.7	0.7	0.7	0.3	0.3	0.3
16	6.1	0.0	0.0	0.0	0.0	0.0	0.0	1.4	1.4	1.4	0.2	0.2	0.2	0.1	0.1	0.1
17	1.5	0.3	0.3	0.3	0.1	0.1	0.1	0.5	0.5	0.5	0.2	0.2	0.2	0.1	0.1	0.1
18	1.5	1.2	1.2	1.3	0.1	0.1	0.1	3.0	3.0	3.0	0.7	0.7	0.7	0.5	0.5	0.6
19	1.5	2.2	2.2	2.2	0.1	0.1	0.1	0.5	0.5	0.5	0.1	0.1	0.1	0.5	0.5	0.5
20	1.5	2.7	2.7	2.7	0.3	0.3	0.3	9.7	9.7	9.7	1.5	1.5	1.5	1.1	1.1	1.1
21	1.5	0.9	0.9	0.9	0.3	0.3	0.3	10.2	10.2	10.2	1.9	1.9	1.9	0.8	0.8	0.9
22	1.5	0.2	0.2	0.3	0.1	0.1	0.1	3.9	3.9	3.9	0.8	0.8	0.8	0.3	0.3	0.4
23	6.1	0.4	0.4	0.4	0.4	0.4	0.4	65.0	65.0	65.0	12.0	12.0	12.0	3.3	3.3	3.3
24	6.1	0.1	0.1	0.1	0.1	0.1	0.1	4.4	4.4	4.4	1.0	1.0	1.0	0.4	0.4	0.4
25	1.5	7.4	7.4	7.4	0.5	0.5	0.5	38.9	38.9	38.9	2.3	2.3	2.3	1.8	1.8	1.8

TABLE 21 (continued)

26	1.5	16.0	16.0	16.0	1.0	1.0	1.0	3.0	3.0	3.0	0.5	0.5	0.5	3.1	3.1	3.1
27	1.5	137.2	137.2	135.4	3.7	3.7	3.7	8.0	8.0	8.0	2.5	2.5	2.5	36.4	36.4	35.9
28	1.5	0.4	0.4	0.4	0.1	0.1	0.1	5.3	5.3	5.3	0.9	0.9	0.9	0.4	0.4	0.4
29	1.5	0.3	0.3	0.4	0.1	0.1	0.1	6.7	6.7	6.7	1.1	1.1	1.1	0.5	0.5	0.5
30	1.5	0.3	0.3	0.3	0.1	0.1	0.1	8.8	8.8	8.8	1.2	1.2	1.2	0.6	0.6	0.6
31	6.1	0.0	0.0	0.0	0.1	0.1	0.1	0.7	0.7	0.7	0.2	0.2	0.2	0.1	0.1	0.1
32	6.1	0.1	0.1	0.1	0.1	0.1	0.1	5.0	5.0	5.0	1.0	1.0	1.0	0.5	0.5	0.5
33	1.5	0.0	0.0	0.1	0.1	0.1	0.1	3.7	3.7	3.7	0.7	0.7	0.7	0.2	0.2	0.3
34	1.5	0.0	0.0	0.1	0.1	0.1	0.1	6.6	6.6	6.6	1.1	1.1	1.1	0.4	0.4	0.5
35	1.5	0.0	0.0	0.0	0.1	0.1	0.1	7.4	7.4	7.4	1.1	1.1	1.1	0.5	0.5	0.5
36	1.5	0.0	0.0	0.0	0.1	0.1	0.1	6.1	6.1	6.1	1.0	1.0	1.0	0.4	0.4	0.5
37	1.5	0.1	0.1	0.1	0.0	0.0	0.0	3.6	3.6	3.6	0.5	0.5	0.5	0.3	0.3	0.3
38	1.5	0.1	0.1	0.2	0.1	0.1	0.1	0.7	0.7	0.7	0.4	0.4	0.4	0.1	0.1	0.2
39	1.5	1.4	1.4	1.4	0.2	0.2	0.2	5.3	5.3	5.3	0.9	0.9	1.0	0.6	0.6	0.6
40	1.5	0.3	0.3	0.3	0.2	0.2	0.2	7.7	7.7	7.7	1.3	1.3	1.3	0.6	0.6	0.7
41	1.5	0.1	0.1	0.2	0.1	0.1	0.2	6.5	6.5	6.5	1.3	1.3	1.3	0.5	0.5	0.6
42	1.5	0.0	0.0	0.1	0.1	0.1	0.1	5.5	5.5	5.5	1.2	1.2	1.2	0.5	0.5	0.5
43	6.1	0.2	0.2	0.2	0.2	0.2	0.2	14.7	14.7	14.7	2.3	2.3	2.3	1.0	1.0	1.0
44	6.1	0.5	0.5	0.5	2.1	2.1	2.1	12.8	12.8	12.8	3.2	3.2	3.2	1.3	1.3	1.3
45	1.5	0.0	0.0	0.0	0.1	0.1	0.1	1.8	1.8	1.8	0.4	0.4	0.4	0.1	0.1	0.2
46	1.5	0.0	0.0	0.1	0.1	0.1	0.1	2.0	2.0	2.0	0.5	0.5	0.5	0.1	0.1	0.2
47	1.5	0.3	0.3	0.4	0.1	0.1	0.1	3.1	3.1	3.1	0.6	0.6	0.6	0.3	0.3	0.3
48	1.5	0.0	0.0	0.0	0.1	0.1	0.1	2.5	2.5	2.5	0.5	0.5	0.5	0.2	0.2	0.2
49	1.5	0.1	0.1	0.1	0.1	0.1	0.1	2.6	2.6	2.6	0.6	0.6	0.6	0.3	0.3	0.3
50	1.5	0.0	0.0	0.1	0.1	0.1	0.1	1.1	1.1	1.1	0.4	0.4	0.4	0.1	0.1	0.2
51	1.5	0.1	0.1	0.2	0.1	0.1	0.1	3.8	3.8	3.8	0.9	0.9	0.9	0.3	0.3	0.4
52	1.5	0.0	0.0	0.0	0.1	0.1	0.1	1.5	1.5	1.5	0.4	0.4	0.4	0.1	0.1	0.2
53	1.5	0.0	0.0	0.0	0.1	0.1	0.1	1.5	1.5	1.5	0.4	0.4	0.4	0.1	0.1	0.2
54	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.6	0.6	0.1	0.1	0.1	0.1	0.1	0.1

TABLE 21 (continued)

55	6.1	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.4	0.4	0.1	0.1	0.1	0.0	0.0	0.0
56	6.1	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.7	0.7	0.1	0.1	0.1	0.1	0.1	0.1
57	6.1	0.0	0.0	0.0	0.1	0.1	0.1	3.0	3.0	3.0	0.6	0.6	0.6	0.2	0.2	0.2
58	6.1	0.0	0.0	0.0	0.1	0.1	0.1	1.9	1.9	1.9	0.4	0.4	0.4	0.1	0.1	0.2
59	6.1	0.1	0.1	0.1	0.2	0.2	0.2	7.7	7.7	7.7	1.7	1.7	1.7	0.8	0.8	0.8
60	6.1	0.1	0.1	0.1	0.1	0.1	0.1	1.4	1.4	1.4	0.4	0.4	0.4	0.2	0.2	0.2
61	6.1	0.1	0.1	0.1	0.1	0.1	0.1	3.0	3.0	3.0	0.7	0.7	0.7	0.3	0.3	0.3
62	6.1	1.2	1.2	1.2	0.1	0.1	0.1	0.6	0.6	0.6	0.2	0.2	0.2	0.3	0.3	0.3

EMISSION DENSITIES

Emission density maps are presented to provide a visual representation of the emission of pollutants by grid. Figures 6 through 10 illustrates the variation in emission densities for the respective grids throughout the Study Area. As expected, the emissions generally follow the pattern and degree of urbanization. Thus emission densities are higher in grids with dense populations and correspondingly high vehicular and industrial activity.

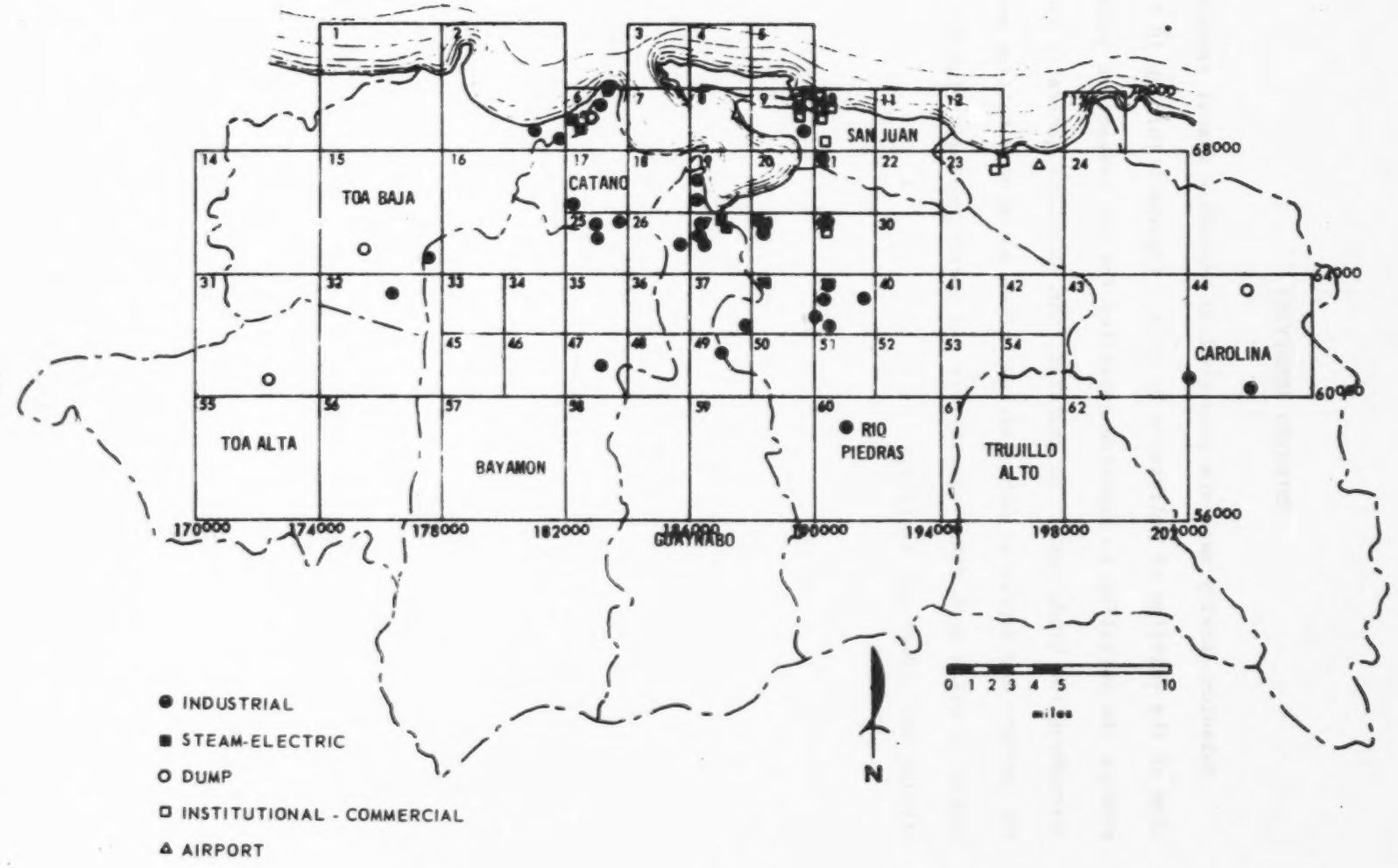

Figure 5. Point source locations in Puerto Rico study area.

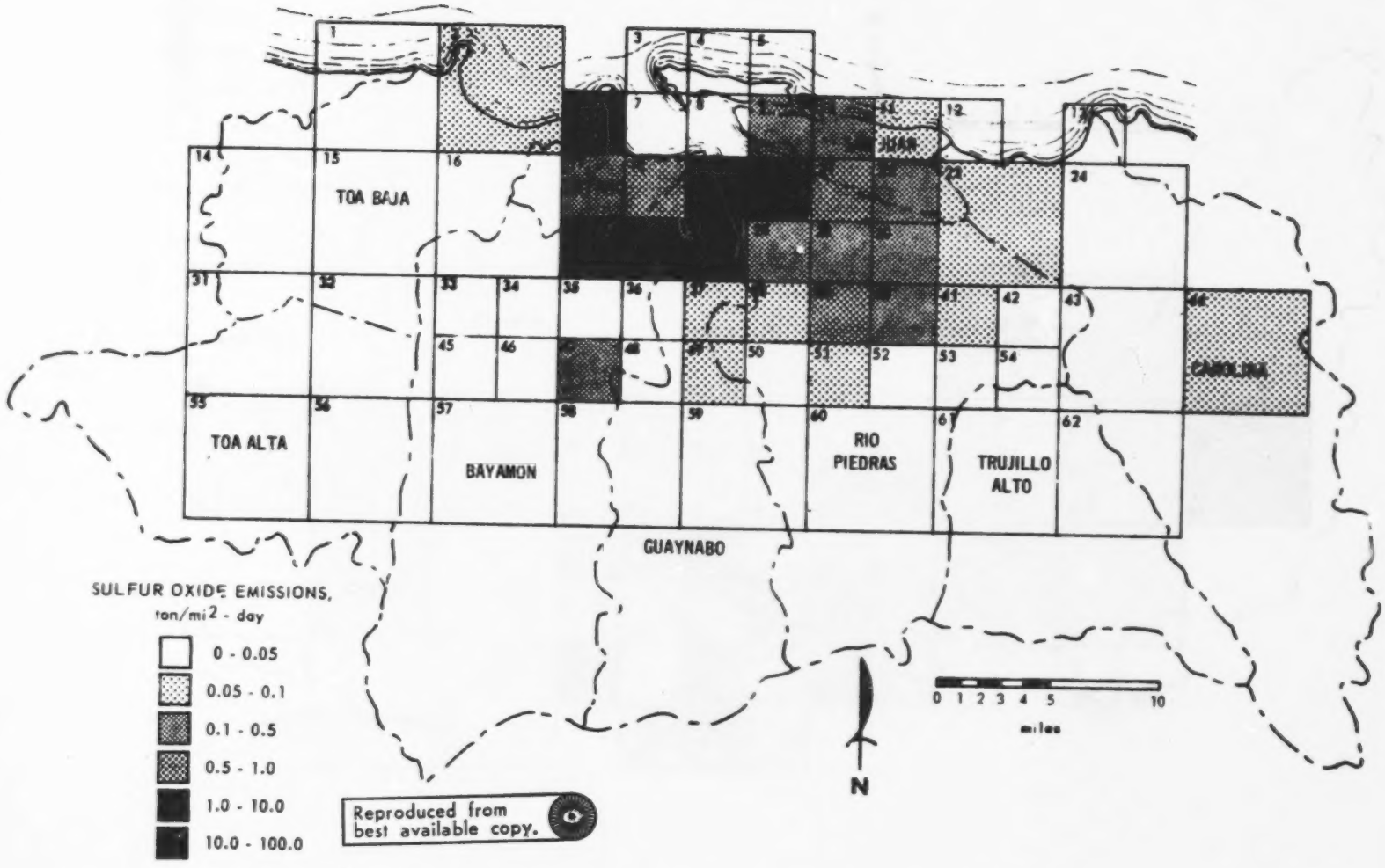

Figure 6. Sulfur oxide emission density from all sources in Puerto Rico study area.

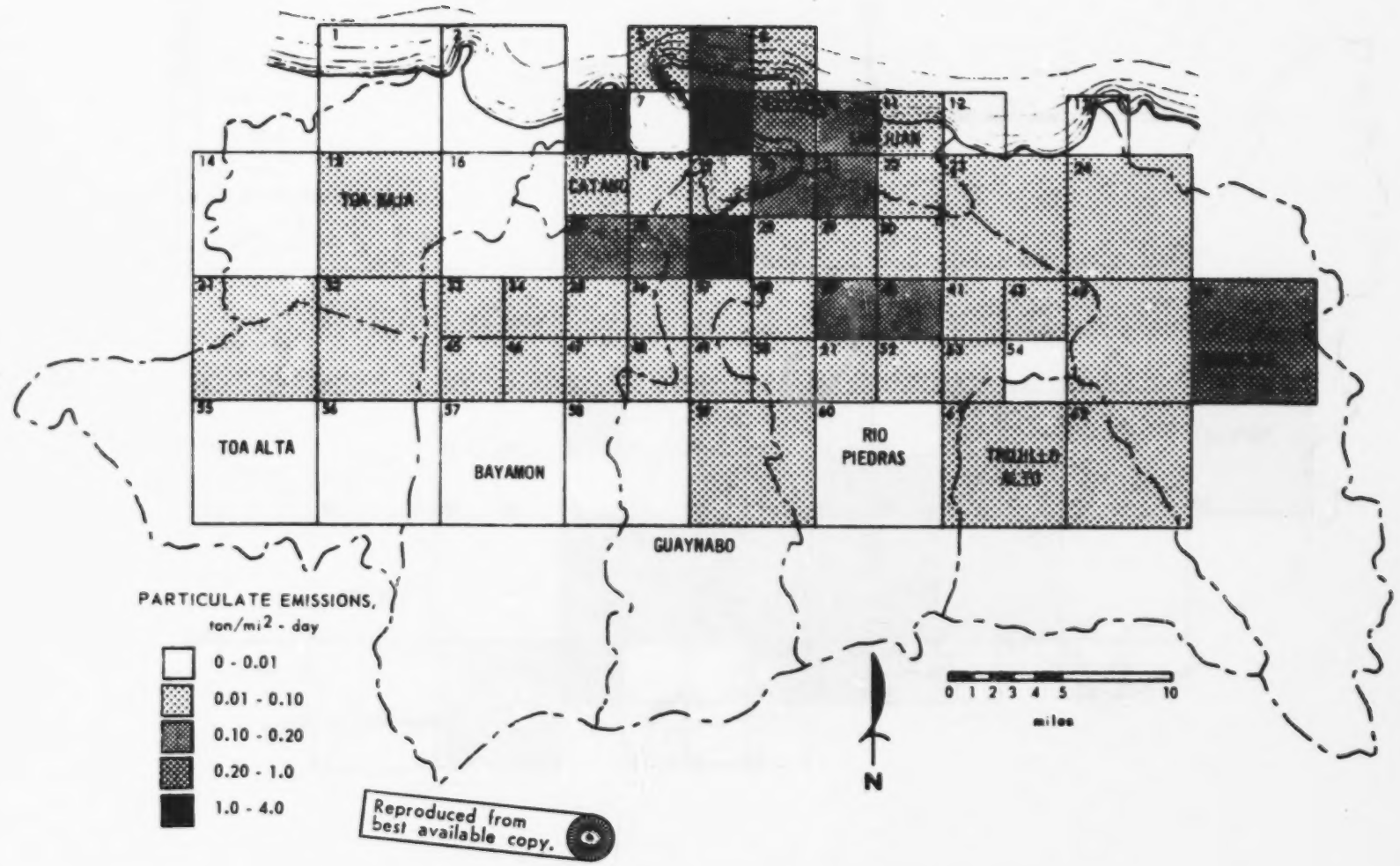

Figure 7. Particulate emission density from all sources in the Puerto Rico study area.

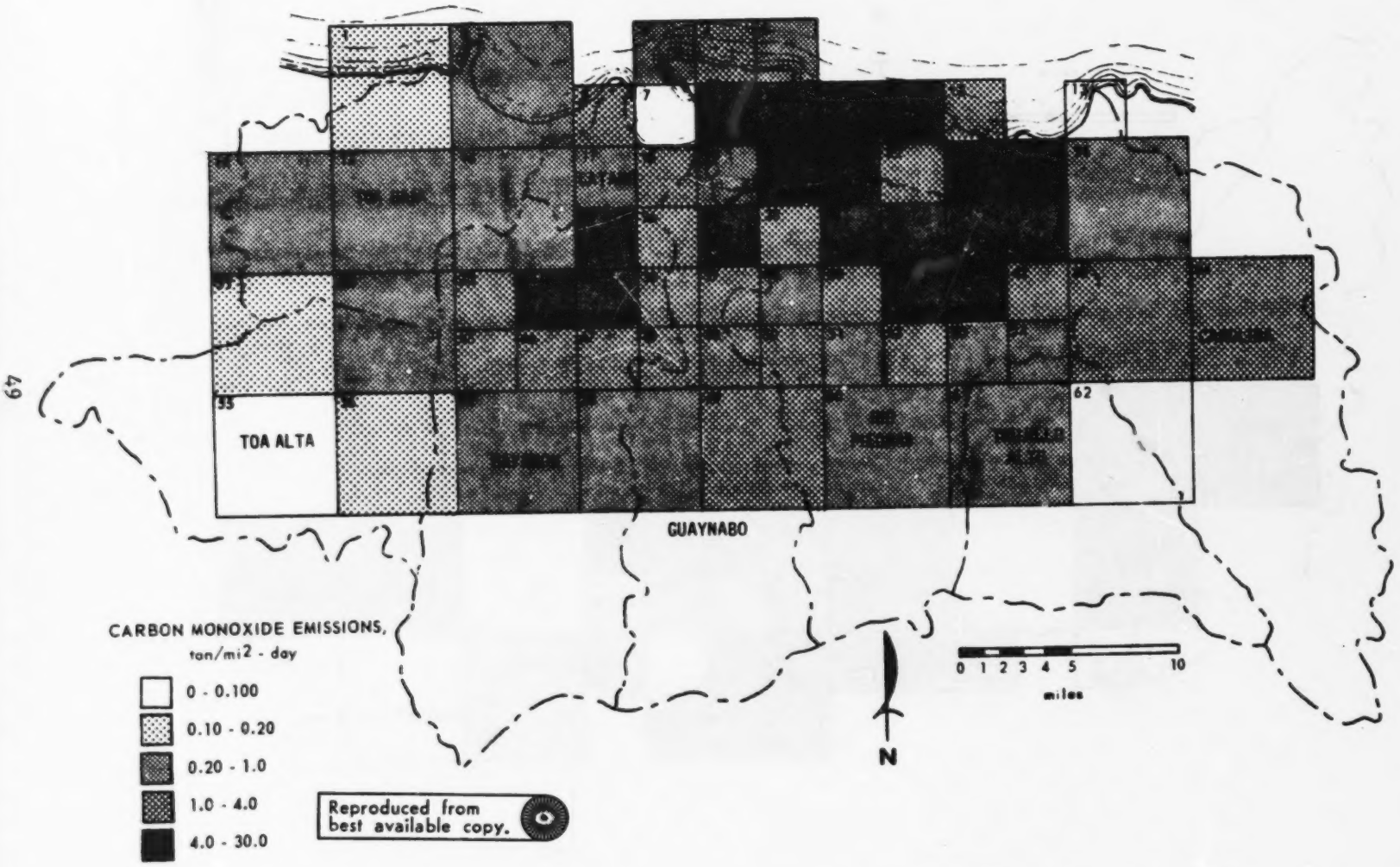

Figure 8. Carbon monoxide density from all sources in Puerto Rico study area.

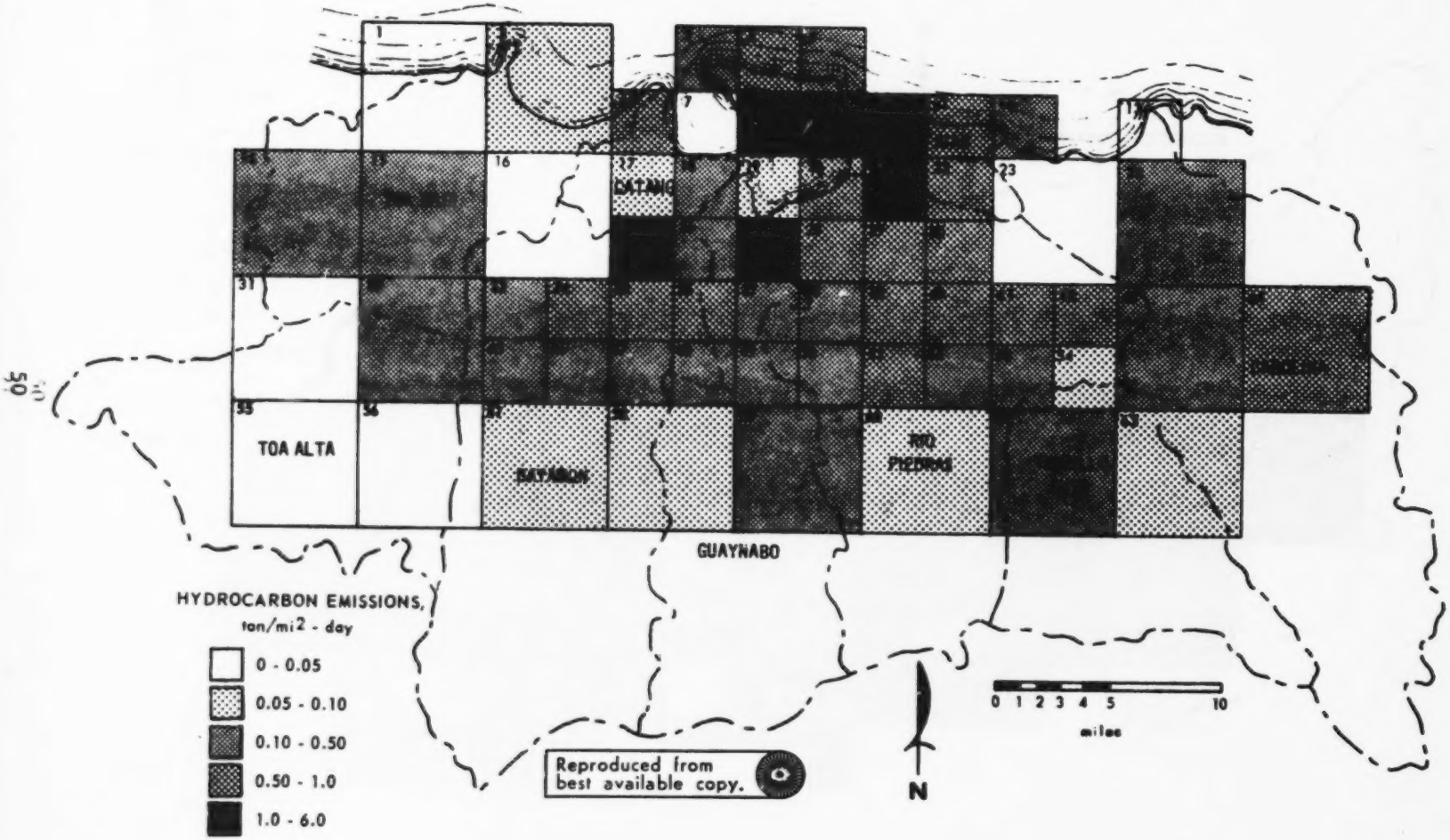

Figure 9. Hydrocarbon emission density from all sources in Puerto Rico study area.

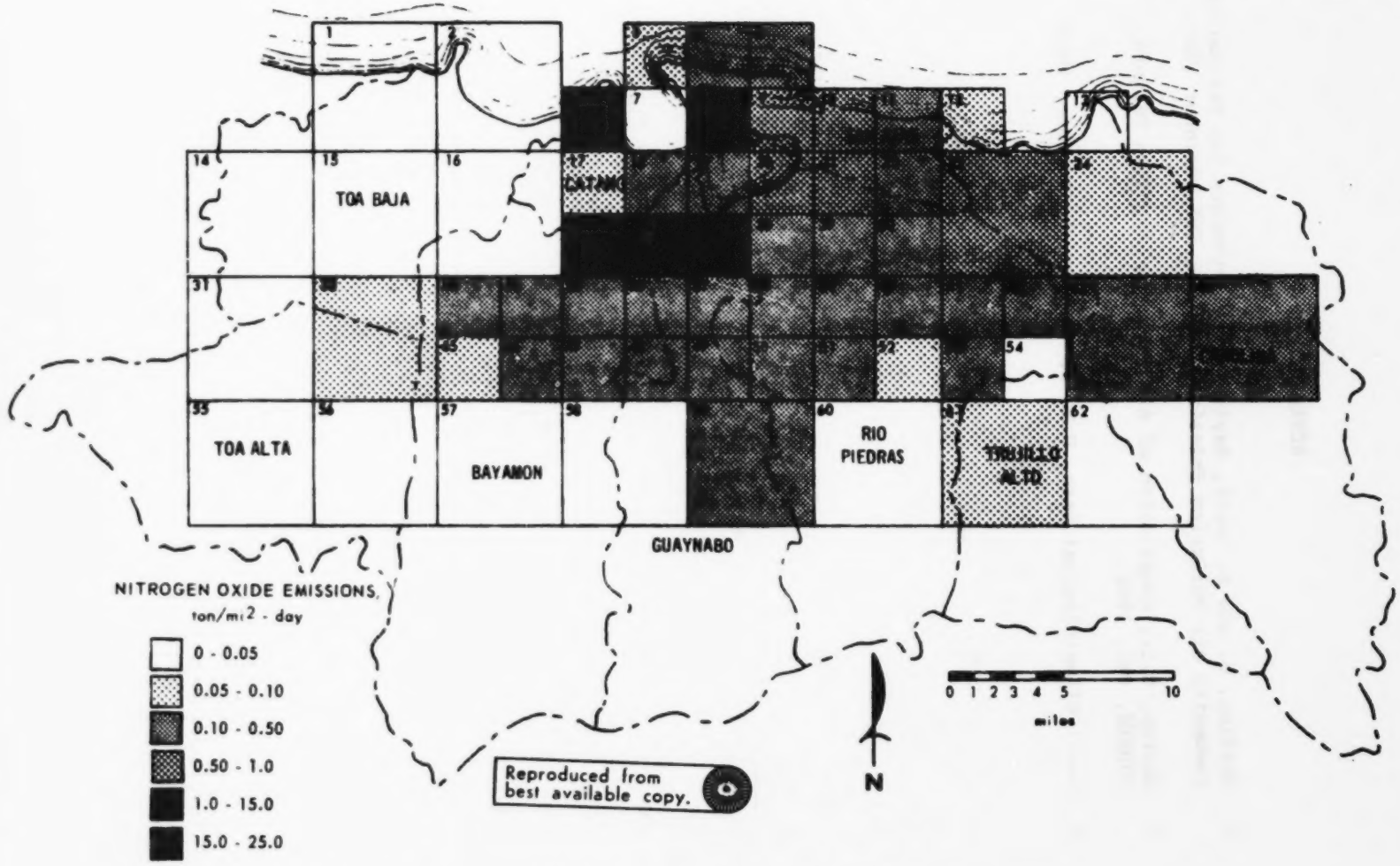

Figure 10. Nitrogen oxide emission density from all sources in Puerto Rico study area.

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1. Ozolins, G. and R. Smith, Rapid Survey Technique for Estimating Community Air Pollution Emissions, USDHEW, PHS, October 1966.

2. Duprey, R.L., Compilation of Air Pollutant Emission Factors, USDHEW, PHS, 1968.

3. Local Climatoligical Data, U.S. Department of Commerce, 1969.

APPENDIX A

METHOD FOR CALCULATING SUMMER, WINTER AND ANNUAL AVERAGE EMISSIONS FOR FUEL CONSUMPTION IN STATIONARY SOURCES

YEARLY AVERAGE (A)

$$A = \frac{\text{Fuel Consumed} \times \text{Emission Factor (E. F.)}}{\text{Days of Operation}}$$

e.g. A plant consumed 100,000 tons of coal in 1967 while operating 365 days. The total degree days for the area was 4,800 and 2,800 for the three winter months. The plant was estimated to use 15 percent of the fuel for space heating and 85 percent for process heating. From this information, the annual average emission for carbon monoxide would be the following:

$$A = \frac{100{,}000 \text{ Tons/year} \times 3 \text{ lbs. CO/Ton coal}}{365 \text{ Days/year} \times 2{,}000 \text{ lb./Ton}}$$

$$A = 0.41 \text{ Ton/Day}$$

WINTER AVERAGE (W)

$$W = \frac{\text{Fuel Consumed} \times \text{E.F.}}{\text{Days of Winter Operation}} \times \frac{\text{Winter Degree Days}}{\text{Total Degree Days}} \times \text{\% Fuel Used for space heating}$$

$$+ \frac{\text{Fuel Consumed} \times \text{E.F.}}{365} \times \text{\% Fuel used for process heating}$$

$$W = \left[\frac{100{,}000 \times 2{,}800}{90 \times 4{,}800} \times 0.15 + \frac{100{,}000}{365} \times 0.85\right] \frac{3}{2{,}000}$$

$$W = 0.49 \text{ Ton/Day}$$

SUMMER AVERAGE (S)

$$S = \frac{\text{Fuel Consumed} \times \text{E.F.}}{\text{Days of Summer Operation}} \times \frac{\text{Summer Degree Days}}{\text{Total Degree Days}} \times \text{\% Fuel Used for space heating}$$

$$+ \frac{\text{Fuel Consumed} \times \text{E.F.}}{365} \times \text{\% Fuel used for process heating}$$

$$S = \left[\frac{100{,}000}{90} \times \frac{0}{4{,}800} \times 0.15 + \frac{100{,}000}{365} \times 0.85\right] \frac{3}{2{,}000}$$

$$S = 0.35 \text{ Ton/Day}$$

APPENDIX B

METRIC CONVERSION FACTORS

Multiply	By.	To Obtain
Feet	0.3048	Meters
Miles	1609	Meters
Square Feet	0.0929	Square meters
Square Miles	2.59	Square kilometers
Pounds	453.6	Grams
Pounds	$453.6/10^4$	Tons (metric)
Tons (metric)	1.103	Tons (short)
Tons (short)	907.2	Kilograms
Tons (short)	.9072	Tons (metric)

To Obtain	By	Divide